SINGLE-TRIGGER CLAMPING AND FIRING OF SURGICAL STAPLER

FIELD OF THE INVENTION

The invention generally relates to surgical instruments, and more specifically to the actuation of surgical instruments.

BACKGROUND

Minimally invasive surgery is performed through small incisions in the body, into which trocar ports may or may not be placed. One or more surgical instruments are inserted through each incision in order to perform the surgical procedure. In order to effectuate one of the objectives of minimally invasive surgery, which is the minimization of incisions to the body to reduce healing time and scarring, it is desirable to minimize the number of incisions made in the body. The number of incisions and their placement are determined by the particular surgical procedure to be performed and the configuration of the instruments used to carry out that procedure.

One problem encountered during the performance of surgical stapling in a minimally-invasive procedure, or even an open surgical procedure, is the need for different triggers on a surgical stapler for clamping and for staple deployment. The use of multiple triggers increases the complexity of use of, the part count of, and the size of a surgical stapler.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a surgical stapler.

FIG. **2** is a side cutaway view of a handle of the surgical stapler of FIG. **1**.

FIG. **3** is a side cutaway view of the handle of the surgical stapler of FIG. **1**, from the side opposite to FIG. **2**, showing a clamping system in isolation.

FIG. **4** is a side view of a clamp lock in an unclamped position.

FIG. **5** is a perspective view of the clamp lock of FIG. **4**.

FIG. **6** is a perspective view of the clamp lock of FIG. **4**, including the unclamp rod and release buttons.

FIG. **7** is a side cutaway view of the handle of the surgical stapler of FIG. **1**, from the same side as FIG. **2**, showing a deployment system in isolation.

FIG. **8** is a perspective cutaway view of the handle of the surgical stapler of FIG. **1**, from the same side as FIG. **2**, showing a mode switching system in isolation.

FIG. **9** is a different perspective view of the mode switching system in isolation of FIG. **8**, in an initial position.

FIG. **10** is a perspective cross-section view of a mode switch in an initial, neutral position.

FIG. **11** is a top cross-section view of FIG. **10**.

FIG. **12** is a perspective view of the mode switch of FIG. **10** and part of the clamp lock of FIG. **4** in a clamped position.

FIG. **13** is a top cross-section view of FIG. **10** in a deployment position.

FIG. **14** is a different perspective view of the mode switching system in isolation of FIG. **9**, in an initial position.

FIG. **15** is a side view of the clamp lock of FIG. **4** in a clamped position.

FIG. **16** is a perspective view of the deployment system of FIG. **7** in deployment mode, before firing staples.

FIG. **17** is the perspective view of FIG. **16**, after firing staples.

The use of the same reference symbols in different figures indicates similar or identical items.

DETAILED DESCRIPTION

U.S. Pat. No. 7,954,683, issued on Jun. 7, 2011, and U.S. Pat. No. 7,988,026, issued on Aug. 2, 2011 (the "Endocutter Documents"), are herein incorporated by reference in their entirety.

Referring to FIG. **1**, an exemplary surgical stapler **2** may include an end effector **4**, which in turn includes a staple holder **8** and an anvil **6**, where at least one of the staple holder **8** and the anvil **6** are rotatable and/or otherwise movable relative to one another. Alternately, the staple holder **8** and the anvil **6** may be directly connected to one another in any other suitable manner, if desired. The staple holder **8** and anvil **6** may be configured substantially as set forth in the Endocutter Document. As another example, the staple holder **8** may be a single-use cartridge, detachable from a remainder of the end effector **4**. If so, the feeder belt of the Endocutter Document may be fixed to the cartridge, or movable relative to the cartridge. As another example, where the staple holder **8** is a detachable cartridge, it may hold a number of individual, conventional staples. The staple holder **8** and anvil **6** may be fabricated from any suitable material or materials. As one example, both the staple holder **8** and anvil **6** may be fabricated from stainless steel. As another example, at least one of the staple holder **8** and anvil **6** may be fabricated at least in part from a ceramic material, to provide enhanced stiffness. As another example, the end effector **4** may be any other suitable item for treating or visualizing tissue, such as but not limited to at least one electrode (bipolar or otherwise), adhesive applicator, camera, ultrasound emitter, forceps, or other items. The end effector **4** may be connected to the distal end of a shaft **10**. The shaft **10** may be rigid along part or all of its length. Alternately, the shaft **10** may be flexible in whole or in part, or may include an articulating region, such as described in U.S. Pat. No. 7,918,376, issued on Apr. 5, 2011 (the "Articulation Document"), which is hereby incorporated by reference in its entirety.

The handle **12** may be attached to the proximal end of the shaft **10**, or any other suitable portion of the shaft **10**. The shaft **10** may be fabricated integrally with the handle **12**. Alternately, the shaft **10** and the handle **12** may be two separate items that are connected together in any suitable manner. The handle **12** may include any mechanism, mechanisms, structure or structures that are suitably configured to actuate the end effector **4**. The handle **12** may be actuated purely by hand, meaning that the handle **12** mechanically converts force applied thereto by hand to force utilized to actuate the end effector **4**. As another example, the handle **12** may include a source of stored energy for actuating the end effector **4**. The source of stored energy may be mechanical (such as a spring), electrical (such as a battery), pneumatic (such as a cylinder of pressurized gas) or any other suitable source of stored energy. The source of stored energy, its regulation, and its use in actuating the end effector **4** may be as described in commonly-assigned U.S. Pat. No. 7,682,368, issued on Mar. 23, 2010, which is herein incorporated by reference in its entirety. The handle **12** may instead, or also, include a connector or connectors suitable for receiving stored energy from an external source, such as a hose connected to a hospital utility source of pressurized gas or of vacuum, or an electrical cord connectable to a power source.

The handle **12** may include a trigger **14** and a mode button **16**. Advantageously, the handle **12** includes a single trigger **14**. The single trigger **14** both clamps the end effector **4** and